

**REMARKS**

The Office Action mailed November 28, 2005, has been received and reviewed. Claims 1 through 59 are currently pending in the application. Claims 1 through 59 stand rejected. Claims 29 and 42 has been amended to correct typographical errors. Applicants have amended independent claims 1, 9, 16, 32, and 49 to recite new limitations that are not described, taught, or suggested by the cited prior art references, and respectfully request reconsideration of the application as amended herein.

Furthermore, Applicants have amended each of independent claims 1, 16, 32, and 49 to delete the limitation "the hydrophilic polymer constituent and the inorganic oxide constituent form an **interpenetrating network** with each other," as the Examiner apparently does not consider this limitation to lend patentability to the claims over the cited prior art references. As such, the scope of each of claims 1, 16, 32, and 49 as amended herein, is intended to encompass nanocomposite materials that include a hydrophilic polymer constituent and an inorganic oxide constituent that either do or do not form an interpenetrating network with each other, as set forth in the claims.

**Information Disclosure Statement**

The Examiner has indicated in the outstanding Office Action that references were submitted by the Applicants that were not listed in an Information Disclosure Statement. No further description was provided regarding the documents to which the Examiner is referring. An Information Disclosure Statement was filed herein on December 9, 2003. A series of literature documents were submitted therewith relating to a seminar entitled "In Situ Permeable Reactive Barriers: Application and Deployment Training Session." These documents were cited in the Information Disclosure Statement and the corresponding Form PTO/SB/08B as "In Situ Permeable Reactive Barriers: Application and Deployment Training Session, EPA/ITRC/RTDF, Feb. 8-9, 2000." The corresponding entry on the Form PTO/SB/08B was initialed by the Examiner and has been returned to the Applicants.

During a telephone conference on February 1, 2006 between the Examiner and J. Jeffrey Gunn, the Examiner indicated that the references to which the Examiner was referring were

documents relating to the above described seminar that contained material that was not relevant to the present invention, such as lists of restaurants close to the venue at which the seminar was held. As these references are not material to the patentability of the present invention, they will not be resubmitted in an additional Information Disclosure Statement.

### 35 U.S.C. § 112 Claim Rejections

Claims 49 through 59 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. Applicants respectfully traverse this rejection, as hereinafter set forth.

Applicants have amended independent claim 49 to change the recited element of “an organic constituent” to “an organic oxide constituent” to remediate the lack of antecedent basis noted by the Examiner in the outstanding Office Action.

### 35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers”

Claims 1 through 3, 5, 7, 9 through 11, 16 through 18, 20, 22, 31 through 34, 36, 38, 49, 52, 53, 55, 57 and 58 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers.” Applicants respectfully traverse this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable

expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Applicants respectfully assert that claims 1 through 3, 5, 7, 9 through 11, 16 through 18, 20, 22, 31 through 34, 36, 38, 49, 52, 53, 55, 57 and 58 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering the cited prior art references because, when combined, the prior art references do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claims 1, 16, 32, and 49, as currently amended. In addition, the cited prior art references, when combined, do not teach or suggest “**tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability** to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9, as currently amended.

Polson et al. teaches “nanocomposites, which combine polymers with ceramics” for use in “subsurface remediation efforts” “through the formation of an *in-situ* permeable reactive barrier (PRB).” The permeable reactive barrier allows for “selective mass transport through the barrier wall to control environmental contaminants.” “The ceramic component of the composite transforms a water-soluble organic polymer into a new material with the same properties as a hydrogel.” “The concept allows water and other benign species to flow through the PRB, while blocking the flow of contaminants of concern.” Polson et al. also mentions the incorporation of “selective cesium capturing agents, such as aminomolybdophosphate (AMP).”

Polson et al. does not teach or suggest a nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, or tailoring the concentration of a hydrophilic polymer in a mixture to impart a predetermined water permeability to a nanocomposite material, as recited in independent claims 1, 9, 16, 32, and 49.

Novak et al. teaches a method of forming organic-inorganic composites through either a

radical or a ring-opening metathesis polymerization (ROMP) mechanism. In particular, hydrolysis and condensation of precursor tetraalkoxysilanes possessing polymerizable alkoxide groups is carried out in the presence of a polymerizable cosolvent to produce a SiO<sub>2</sub> gel, which is swollen with liberated polymerizable alcohols, which can then undergo coincident polymerization. The method results in the formation of sol-gel composites in which all of the initial components are incorporated directly into the solid.

Novak et al. does not teach or suggest a nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, or tailoring the concentration of a hydrophilic polymer in a mixture to impart a predetermined water permeability to a nanocomposite material, as recited in independent claims 1, 9, 16, 32, and 49.

As Polson et al. and Novak et al., when combined, do not teach or suggest each of the limitations recited in each of independent claims 1, 9, 16, 32, and 49, Applicants respectfully assert that each of independent claims 1, 9, 16, 32, and 49 could not have been obvious to a person of ordinary skill in the art at the time each invention was made considering Polson et al. in view of Novak et al., and request that the Examiner withdraw the rejection of independent claims 1, 9, 16, 32, and 49 under 35 U.S.C. § 103(a).

Furthermore, regarding claim 9, Applicants additionally assert that there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the teachings of Novak et al. to provide a solvated hydrophilic polymer, as recited therein. The Examiner asserts at Page 5 of the outstanding Office Action that "Novak discloses dissolving ... polymers to form interpenetrating networks." Applicants respectfully disagree and assert that Novak et al. describes interpenetrating networks, but does not describe dissolving polymers to form such interpenetrating networks. Furthermore, Novak et al. teaches away from providing a **solvated** hydrophilic polymer. In particular, Novak et al. states (beginning at the fourth line of the third full paragraph of the first column on the first page (698))

"[w]e, as well as others, have been interested in forming semi-interpenetrating

networks fashioned by dissolving preformed polymers in the sol-gel solutions, and allowing the SiO<sub>2</sub> network to form around the polymer domains. In an effort to provide better phase homogeneity, between the two chemically dissimilar phases and to increase the mechanical strength of these interesting composite materials, we began investigations into the formation of simultaneous interpenetrating networks (SIPN's) by the **synchronous formation** of both a cross-linked inorganic glass and a cross-linked organic polymer.”

Novak et al. then describes in detail two mechanisms for simultaneously polymerizing a polymer material and forming a cross-linked inorganic glass. In other words, Novak et al. suggests that composite materials made by dissolving polymers in a solvent exhibit inferior homogeneity and mechanical strength, and that composite materials made instead by simultaneous, synchronous formation of a polymer material from polymer precursor materials and formation of a cross-linked inorganic glass are superior and preferable. Therefore, Novak et al. teaches away from providing a **solvated** hydrophilic polymer, as recited in independent claim 9.

Therefore, Applicants respectfully assert that independent claim 9 could not have been obvious to one of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al., and request that the Examiner withdraw the rejection of independent claim 9 under 35 U.S.C. § 103(a) for this additional reason.

A dependent claim is obvious only if the independent claim from which it depends is obvious. *See In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988), *see also* MPEP § 2143.03. Therefore, the nonobviousness of independent claim 1 precludes a rejection of claims 2, 3, 5, and 7, the nonobviousness of independent claim 9 precludes a rejection of claim 11, the nonobviousness of independent claim 16 precludes a rejection of claims 17, 18, 20, 22, and 31, the nonobviousness of independent claim 32 precludes a rejection of claims 33, 34, 36, and 38, and the nonobviousness of independent claim 49 precludes a rejection of claims 52, 53, 55, 57, and 58. Therefore, Applicants request that the Examiner withdraw the 35 U.S.C. § 103(a) obviousness rejection to claims 2, 3, 5, 7, 10, 11, 17, 18, 20, 22, 31, 33, 34, 36, 38, 52, 53, 55, 57, and 58, in addition to the rejection to independent claims 1, 9, 16, 32, and 49.

Regarding dependent claim 31, Applicants additionally assert that none of the cited prior art references teach or suggest a permeable reactive barrier system that includes a membrane

comprising “a plurality of discrete particles of [a] nanocomposite material,” as recited in dependent claim 31. Therefore, Applicants respectfully assert that dependent claim 31 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al., and request that the Examiner withdraw the rejection of dependent claim 31 under 35 U.S.C. § 103(a) for this additional reason.

Regarding dependent claim 57, Applicants additionally assert that none of the cited prior art references teach or suggest “chemically binding [a] metal ion contaminant to [a] permeable substantially homogenous nanocomposite material,” as recited in dependent claim 57. Polson et al. suggests incorporating “selective cesium capturing agents” into a permeable reactive barrier, but does not teach or suggest that such cesium capturing agents are incorporated in such a manner as to chemically bind the cesium to a nanocomposite material. Therefore, Applicants respectfully assert that dependent claim 57 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al., and request that the Examiner withdraw the rejection of dependent claim 57 under 35 U.S.C. § 103(a) for this additional reason.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-11, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55 and 57-58 above, and further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties”

Claims 4, 6, 8, 13 through 15, 19, 21, 30, 35, 37, 39, 54, 56, and 59 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-11, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55 and 57-58 above, and further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties.” Applicants respectfully traverse this rejection, as hereinafter set forth.

Each of claims 4, 6, and 8 depends from claim 1, each of claims 13 through 15 depends from claim 9, each of claims 19, 21, and 30 depends from claim 16, each of claims 35, 37, and 39 depends from claim 32, and each of claims 54, 56, and 59 depends from claim 49. Each of these dependent claims includes the elements and limitations recited in the independent claim from which each respectively depends.

Applicants respectfully assert that claims 4, 6, 8, 13 through 15, 19, 21, 30, 35, 37, 39, 54, 56, and 59 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering Polson et al. in view of Novak et al. because the cited prior art references, when combined, do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claims 1, 16, 32, and 49, as currently amended. In addition, Polson et al. and Novak et al., when combined, do not teach or suggest “**tailoring the concentration of [a] hydrophilic polymer** in [a] mixture **to impart a predetermined water permeability** to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9, as currently amended.

As previously discussed herein, Polson et al. and Novak et al., when combined, do not teach or suggest a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a selected water permeability to the nanocomposite material,” as recited in independent claims 1, 16, 32, and 49, or “tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9. The teachings of Sebesta et al. do not satisfy the deficiency.

Sebesta et al. describes a composite ion exchanger that includes an organic binding polymer based on polyacrylonitrile (PAN) and ammonium molybdophosphate (AMP) as an active component for adsorption of cesium. Sebesta et al. suggests using such composite ion exchanges for purification of liquid wastes discharged into the environment.

Sebesta et al. does not, however, teach or suggest a nanocomposite material, a

nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, or tailoring the concentration of a hydrophilic polymer in a mixture to impart a predetermined water permeability to a nanocomposite material, as recited in independent claims 1, 9, 16, 32, and 49.

As Polson et al., Novak et al., and Sebesta et al., when combined, do not teach or suggest each of the limitations of any one of dependent claims 4, 6, 8, 13 through 15, 19, 21, 30, 35, 37, 39, 54, 56, and 59, none of these claims could have been obvious to a person of ordinary skill in the art at the time the inventions were made considering Polson et al. in view of Novak et al, and further in view of Sebesta et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 4, 6, 8, 13 through 15, 19, 21, 30, 35, 37, 39, 54, 56, and 59 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties” as applied to claims 1-11, 13-22, 30, 31-39, 49, 52-59 above, and further in view of Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach”

Claim 12 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties” as applied to claims 1-11, 13-22, 30, 31-39, 49, 52-59 above, and further in view of Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach.” Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 12 depends indirectly from claim 9, and, as a result, includes the elements and limitations recited in independent claim 9.

Applicants respectfully assert that claim 12 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art



references because, when combined, the cited prior art references do not teach or suggest **“tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,”** as recited in independent claim 9, as currently amended.

As previously discussed herein, Polson et al., Novak et al., and Sebesta et al., when combined, do not teach or suggest “tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9. The teachings of Wen et al. do not satisfy the deficiency.

Wen et al. summarize the then-current state of the art of organic/inorganic hybrid network materials formed by the sol-gel technique. Wen et al. teach that tetraethoxysilane may be used as an inorganic precursor for forming an organic/inorganic hybrid network material.

Wen et al. does not, however, teach or suggest tailoring the concentration of a hydrophilic polymer constituent in a nanocomposite material to impart a predetermined water permeability to the nanocomposite material, as recited in independent claim 9.

As Polson et al., Novak et al., Sebesta et al., and Wen et al., when combined, do not teach or suggest each of the limitations of dependent claim 12, dependent claim 12 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al., Novak et al., Sebesta et al., and Wen et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claim 12 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties” and Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach” as applied to claims 1-22, 30-39, 49, 52-59 above, and further in view of EPA/600/R-98/125 “Permeable Reactive Barrier Technologies for Contaminant Remediation”

Claims 24 through 28, 44 through 48, and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties” and Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach” as applied to claims 1-22, 30-39, 49, 52-59 above, and further in view of EPA/600/R-98/125 “Permeable Reactive Barrier Technologies for Contaminant Remediation” (hereinafter referred to as “EPA”). Applicants respectfully traverse this rejection, as hereinafter set forth.

Each of claims 24 through 28 depends from claim 16, each of claims 44 through 48 depends from claim 32, and claim 51 depends from claim 49. As previously discussed, each of these dependent claims includes the elements and limitations recited in the independent claim from which each respectively depends.

Applicants respectfully assert that claims 24 through 28, 44 through 48, and 51 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering the cited prior art references because, when combined, the cited prior art references do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claims 16, 32, and 49, as currently amended.

As previously discussed herein, Polson et al., Novak et al., Sebesta et al., and Wen et al., when combined, do not teach or suggest a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a selected water permeability to the nanocomposite material,” as recited in independent claims 16, 32, and 49. The teachings of EPA do not satisfy the deficiency.

EPA describes the use of permeable reactive barriers for treating contaminated water. EPA teaches providing a membrane in an excavated trench within a portion of the water table in the ground. See EPA, pages 28-29. EPA further describes substantially impermeable walls

positioned and located within the ground to direct flow of groundwater toward the membrane. The walls are disposed at an angle greater than zero degrees in relation to the membrane, and suggest that the walls may be disposed in a portion of the water table. See EPA, FIG. 1 at page 1, and FIG. 8b at page 28.

EPA does not, however, teach or suggest a nanocomposite material, or a nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, as recited in independent claims 16, 32, and 49.

As Polson et al., Novak et al., Sebesta et al., Wen et al., and EPA, when combined, do not teach or suggest each of the limitations recited in any one of dependent claims 24 through 28, 44 through 48, and 51, these claims could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering Polson et al., Novak et al., Sebesta et al., Wen et al., and EPA. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 24 through 28, 44 through 48, and 51 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., "Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials" in view of Novak et al., "Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers" further in view of Sebesta et al., "Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties" and Wen et al., "Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach" and EPA/600/R-98/125 "Permeable Reactive Barrier Technologies for Contaminant Remediation" as applied to claims 1-22, 24-28, 30-39, 44-49, 51-59 above, and further in view of U.S. Patent No. 5,728,302 to Conner et al.

Claims 41 through 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., "Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials" in view of Novak et al., "Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers" further in view of Sebesta et al., "Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties" and Wen et al., "Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach" and EPA/600/R-98/125 "Permeable Reactive Barrier Technologies for Contaminant Remediation" as applied to claims 1-22, 24-28, 30-39, 44-

49, 51-59 above, and further in view of Conner et al. (U.S. Patent No. 5,728,302). Applicants respectfully traverse this rejection, as hereinafter set forth.

Each of claims 41 through 43 depends either directly or indirectly from claim 32 and, as a result, each includes the elements and limitations recited in independent claim 32.

Applicants respectfully assert that claims 41 through 43 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering the cited prior art references because, when combined, the cited prior art references do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claim 32 as currently amended.

As previously discussed herein, Polson et al., Novak et al., Sebesta et al., Wen et al., and EPA, when combined, do not teach or suggest a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material is imparts a selected water permeability to the nanocomposite material,” as recited in independent claims 32. The teachings of Conner et al. do not satisfy the deficiency.

Conner et al. describes introducing an ion exchange resin into a reservoir matrix to act as an “in-situ filter for dissolved radionuclides presenting the reservoir (or aquifer) fluids. Conner et al., column 3, lines 20-25. The fine resin “is directly introduced into the reservoir as a solid phase component of a solid-liquid slurry using high-pressure injection techniques. Conner et al., column 3, lines 25-27.

Conner et al. does not, however, teach or suggest a nanocomposite material, or a nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, as recited in independent claim 32.

As Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, and Conner et al., when combined, do not teach or suggest each of the limitations recited in any one of dependent claims 41 through 43, these claims could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering Polson et al., Novak et al., Sebesta et al., Wen et

al., EPA, and Conner et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 41 through 43 under 35 U.S.C. § 103(a).

Regarding dependent claim 41, Applicants additionally assert that none of the prior art references teach or suggest “injecting **precursor materials of [a] nanocomposite material** into the ground to form [a] membrane,” as recited in dependent claim 41. Therefore, Applicants respectfully assert that dependent claim 41 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references, and request that the Examiner withdraw the rejection of dependent claim 41 under 35 U.S.C. § 103(a) for this additional reason.

Regarding dependent claim 42, Applicants additionally assert that none of the prior art references teach or suggest forming a membrane by “injecting a slurry into the ground, the slurry comprising a plurality of **discrete particles of [a] nanocomposite material** dispersed in a liquid,” as recited in dependent claim 42 as currently amended. Therefore, Applicants respectfully assert that dependent claim 42 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references, and request that the Examiner withdraw the rejection of dependent claim 42 under 35 U.S.C. § 103(a) for this additional reason.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties,” Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach,” EPA/600/R-98/125 “Permeable Reactive Barrier Technologies for Contaminant Remediation” and U.S. Patent No. 5,728,302 to Conner et al. as applied to claims 1-22, 24-28, 30-39, 41-49, 51-59 above, and further in view of U.S. Publication No. 2001/0033772 A1 to Gilmore et al.

Claims 23, 40, and 50 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite

Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties,” Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach,” EPA/600/R-98/125 “Permeable Reactive Barrier Technologies for Contaminant Remediation” and Conner et al. (U.S. Patent No. 5,728,302) as applied to claims 1-22, 24-28, 30-39, 41-49, 51-59 above, and further in view of Gilmore et al. (U.S. Publication No. 2001/0033772 A1). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 23 depends directly from claim 16 and includes the elements and limitations recited therein, claim 40 depends directly from claim 32 and includes the elements and limitations recited therein, and claim 50 depends directly from claim 49 and includes the elements and limitations recited therein.

Applicants respectfully assert that claims 23, 40, and 50 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering the cited prior art references because, when combined, the cited prior art references do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claims 16, 32, and 49 as currently amended.

As previously discussed herein, Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, and Conner et al., when combined, do not teach or suggest a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a selected water permeability to the nanocomposite material,” as recited in independent claims 16, 32, and 49. The teachings of Gilmore et al. do not satisfy the deficiency.

Gilmore et al. describes forming a reactive barrier in a vadose region of the ground. The reactive barrier is formed by modifying the soil or its properties. Gilmore et al., page 2, paragraphs [0019], [0023]; Figure 1.

Gilmore et al. does not, however, teach or suggest a nanocomposite material, or a

nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, as recited in independent claims 16, 32, and 49.

As Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, Conner et al., and Gilmore et al., when combined, do not teach or suggest each of the limitations recited in any one of dependent claims 23, 40, and 50, these claims could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, Conner et al., and Gilmore et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 23, 40, and 50 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., "Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials" in view of Novak et al., "Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers" further in view of Sebesta et al., "Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties," Wen et al., "Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach," EPA/600/R-98/125 "Permeable Reactive Barrier Technologies for Contaminant Remediation," U.S. Patent No. 5,728,302 to Conner et al. and U.S. Publication No. 2001/0033772 A1 to Gilmore et al. as applied to claims 1-28, 30-59 above, and further in view of U.S. Patent No. 5,857,810 to Cantrell et al.

Claim 29 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., "Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials" in view of Novak et al., "Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers" further in view of Sebesta et al., "Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties," Wen et al., "Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach," EPA/600/R-98/125 "Permeable Reactive Barrier Technologies for Contaminant Remediation," Conner et al. (U.S. Patent No. 5,728,302) and Gilmore et al. (U.S. Publication No. 2001/0033772 A1) as applied to claims 1-28, 30-59 above, and further in view of Cantrell et al. (U.S. Patent No. 5,857,810). Applicants respectfully traverse this rejection, as

hereinafter set forth.

Claim 29 depends directly from claim 16 and includes the elements and limitations recited therein.

Applicants respectfully assert that claim 29 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references because, when combined, the cited prior art references do not teach or suggest “a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a **selected water permeability** to the nanocomposite material,” as recited in independent claim 16 as currently amended.

As previously discussed herein, Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, Conner et al., and Gilmore et al., when combined, do not teach or suggest a nanocomposite material including an inorganic oxide constituent and a hydrophilic polymer constituent in which “the concentration of the hydrophilic polymer constituent in the nanocomposite material imparts a selected water permeability to the nanocomposite material,” as recited in independent claim 16. The teachings of Cantrell et al. do not satisfy the deficiency.

Cantrell et al. describes a chemical barrier that includes a colloid suspension that is injected into the subsurface. Cantrell et al., column 2, lines 11-12. Cantrell further discloses that it is preferred that the hydraulic conductivity of the colloid suspension with respect to the subsurface be the same as that observed for water. Cantrell et al., column 4, lines 36-41.

Cantrell et al. does not, however, teach or suggest a nanocomposite material, or a nanocomposite material in which the concentration of a hydrophilic polymer constituent imparts a selected water permeability to the nanocomposite material, as recited in independent claim 16. Furthermore, Cantrell et al. does not teach or suggest a permeable reactive barrier having a membrane that “exhibits a permeability substantially the same as a hydraulic conductivity of the ground the membrane is placed within,” as recited in dependent claim 29

As Polson et al., Novak et al., Sebesta et al., Wen et al., EPA, Conner et al., Gilmore et al., and Cantrell et al., when combined, do not teach or suggest each of the limitations of dependent claim 29, claim 29 could not have been obvious to a person of ordinary skill in the art



at the time the invention was made considering the cited prior art references. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claim 29 under 35 U.S.C. § 103(a).

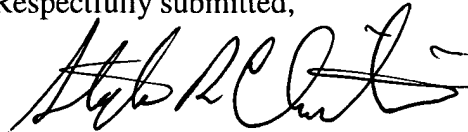
**ENTRY OF AMENDMENTS**

The amendments to claims 1, 9, 16, 29, 32, 42, and 49 above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application.

**CONCLUSION**

Claims 1 through 59 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,



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